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Hiroshi Seta

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EXAMINER

RODGERS, COLLEEN E

ART UNIT

PAPER NUMBER

2813

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

| | | | |
|------------------------------|---------------------------------------|--------------------------------------|--|
| Office Action Summary | Application No. 10/826,366 | Applicant(s) SERA, HIROSHI | |
| | Examiner Colleen E. Rodgers | Art Unit 2813 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 December 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 9-12 is/are rejected.
- 7) ☒ Claim(s) 7 and 8 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date: _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This Office Action responds to the Amendment filed 27 December 2006. By this amendment, claims 1, 4, 5 and 10 are amended. Claims 1-12 are pending.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-4, 6 and 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Chen et al** (US Patent Application Publication 2002/0145142) in view of **Chau et al** (USPN 6,165,826).

Regarding claims 1 and 10, **Chen et al** teaches a method of forming a thin-film semiconductor device, the method including the steps of:

forming a semiconductor film **32** with a predetermined pattern on a substrate **30**;

forming a gate-insulating film **34** on the semiconductor film **32**;

forming a tapered gate electrode **36** [see paragraph 0019, wherein it is noted that the gate electrode may be trapezoidal rather than rectangular] on the gate-insulating film **34**;

implanting a low concentration of impurity into the substrate **30** through the gate electrode **36** functioning as a mask [see paragraph 0020];

forming a layered insulating film composed of at least two different insulating films **40**, **42** on the gate electrode **36** on the substrate **30**, the second insulating film **42** (silicon nitride) having different composition from the first insulating film **40** (silicon oxide);

etching an entire surface of the layered insulating film to form a predetermined pattern in at least one of the layers 42 of the layered insulating film, the predetermined pattern having a width greater than a width of the gate electrode 36 and smaller than a width of the substrate 30 [see Fig. 2D]; and

implanting a high concentration of impurity through the layered insulating film formed according to a predetermined pattern functioning as a mask [see paragraph 0021].

Chen et al does not disclose that the gate electrode is tapered at a 20° to 80° angle. These claims are *prima facie* obvious without a showing that the claimed angles achieve unexpected results relative to the prior art angles. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the angle of tapering provides unexpected results in the gate electrode produced. One of ordinary skill in the art would be motivated to optimize the taper angle to provide for device performance.

Furthermore, **Chen et al** is silent as to what material is used to form the gate-insulating layer 34; therefore, **Chen et al** does not disclose that the first insulating layer and the gate-insulating layer have differing composition. **Chau et al** disclose that nitride is well-known in the art to be a gate dielectric. Since **Chen et al** disclose the first insulating layer 42 to be silicon oxide, it would have been obvious to one of ordinary skill in the art at the time of invention that the gate-insulating layer

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and the second insulating layer would have differing composition, since **Chen et al** teach that nitride is an art-recognized gate-insulating material [see col. 6, lines 28-34].

Finally, neither **Chen et al** nor **Chau et al** disclose wherein the second insulating film has a thickness of more than twice the thickness of the gate electrode. These claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the relative thicknesses provide unexpected results in the semiconductor device produced. One of ordinary skill in the art would be motivated to optimize the relative thicknesses to provide for processing limitations and device performance.

Regarding claim 2, **Chen et al** discloses the method of claim 1 as described above, wherein the uppermost layer 42 of the layered insulating film is isotropically formed and anisotropically etched [see Figs. 2C and 2D].

Regarding claim 3, **Chen et al** discloses the method of claim 2 as described above, wherein anisotropic etching is performed after the formation of the predetermined pattern as shown in Fig. 2D, the predetermined pattern having a width greater than the width of the gate electrode 36 and smaller than the width of the semiconductor film 32 [see Fig. 2E].

Regarding claim 4, **Chen et al** teaches a method of forming a thin-film semiconductor device, the method including the steps of:

forming a semiconductor film 32 with a predetermined pattern on a substrate 30;

forming a gate-insulating film 34 on the semiconductor film 32;

forming a tapered gate electrode 36 [see paragraph 0019, wherein it is noted that the gate electrode may be trapezoidal rather than rectangular] on the gate-insulating film 34;

implanting a low concentration of impurity into the substrate 30 through the gate electrode 36 functioning as a mask [see paragraph 0020];

forming a layered insulating film composed of at least two different insulating films 40, 42 on the gate electrode 36 on the substrate 30;

etching an entire surface of the layered insulating film to form a predetermined pattern in at least one of the layers 42 of the layered insulating film, the predetermined pattern having a width greater than a width of the gate electrode 36 and smaller than a width of the substrate 30 [see Fig. 2D]; and

implanting a high concentration of impurity through the layered insulating film formed according to a predetermined pattern functioning as a mask [see paragraph 0021].

Chen et al is silent as to what material is used to form the gate-insulating layer 34; therefore, **Chen et al** does not disclose that the uppermost insulating layer and the gate-insulating layer have substantially the same composition. **Chau et al** disclose that nitride is well-known in the art to be a gate dielectric. Since **Chen et al** disclose the second insulating layer 42 to be silicon nitride, it would have been obvious to one of ordinary skill in the art at the time of invention that the gate-insulating layer and the second insulating layer would have the same composition, since **Chen et al** teach that nitride is an art-recognized gate-insulating material [see col. 6, lines 28-34].

Furthermore, neither **Chen et al** nor **Chau et al** disclose wherein the layered insulating film has a thickness of more than twice the thickness of the gate electrode. These claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the relative thicknesses provide unexpected results in the semiconductor device produced. One of ordinary skill in the art would be motivated to optimize the relative thicknesses to provide for processing limitations and device performance.

Regarding claim 6, **Chen et al** discloses the method of claim 1 as described above, wherein the etching rate of the upper insulating layer is greater than the etching rate of the lower insulating layer in the first, dry-etching process (etch-selective to the uppermost insulating layer), and the etching rate of the exposed lower insulating layer is greater than the etching rate of the remaining upper insulating layer in the second, wet-etching process (etch-selective to the lower insulating layer). As best understood, it is inherent that in a process utilizing two etch steps, etch selectivity is practiced to control which material is etched by each process.

Regarding claims 9 and 11, **Chen et al** discloses the method of claims 1 and 10 as described above. **Chen et al** furthermore discloses that the insulating film 40 is formed at least along the sides of the gate electrode 36 [see Figs. 2C-2F], and each of the source region and the drain region 48 of

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the semiconductor 32 have a low-concentration region 38 corresponding to a portion of the insulating film 40 with a width greater than the width of the gate electrode 36 [see Fig. 2F].

Regarding claim 12, **Chen et al** discloses the method of claim 11 as described above, wherein the resulting electro-optic apparatus may be included in an LCD display, which is an electronic apparatus [see paragraph 0004].

4. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Chen et al** (US Patent Application Publication 2002/0145142) in view of **Chau et al** (USPN 6,165,826) and **Guldi** (USPN 5,576,230). **Chen et al** teaches a method of forming a thin-film semiconductor device, the method including the steps of:

forming a semiconductor film 32 with a predetermined pattern on a substrate 30;

forming a gate-insulating film 34 on the semiconductor film 32;

forming a tapered gate electrode 36 [see paragraph 0019, wherein it is noted that the gate electrode may be trapezoidal rather than rectangular] on the gate-insulating film 34;

implanting a low concentration of impurity into the substrate 30 through the gate electrode 36 functioning as a mask [see paragraph 0020];

forming a layered insulating film composed of at least two different insulating films 40, 42 on the gate electrode 36 on the substrate 30;

etching an entire surface of the layered insulating film to form a predetermined pattern in at least one of the layers 42 of the layered insulating film, the predetermined pattern having a width greater than a width of the gate electrode 36 and smaller than a width of the substrate 30 [see Fig. 2D]; and

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implanting a high concentration of impurity through the layered insulating film formed according to a predetermined pattern functioning as a mask [see paragraph 0021].

Chen et al is silent as to what material is used to form the gate-insulating layer 34; therefore, **Chen et al** does not disclose that the uppermost insulating layer and the gate-insulating layer have substantially the same composition. **Chau et al** disclose that nitride is well-known in the art to be a gate dielectric. Since **Chen et al** disclose the second insulating layer 42 to be silicon nitride, it would have been obvious to one of ordinary skill in the art at the time of invention that the gate-insulating layer and the second insulating layer would have the same composition, since **Chen et al** teach that nitride is an art-recognized gate-insulating material [see col. 6, lines 28-34].

Furthermore, neither **Chen et al** nor **Chau et al** disclose wherein the layered insulating film has a thickness of more than twice the thickness of the gate electrode. These claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious). In this case, there exists no evidence of record that the relative thicknesses provide unexpected results in the semiconductor device produced. One of ordinary skill in the art would be motivated to optimize the relative thicknesses to provide for processing limitations and device performance.

Finally, neither **Chen et al** nor **Chau et al** disclose that the etching is controlled via endpoint detection. However, **Guldi** teaches that endpoint detection is utilized in wet etching processes [see col. 5, lines 1-6]. It would have been obvious to one of ordinary skill in the art at the time of invention to employ an endpoint detection process as taught by **Guldi** in the method of **Chen et al** and **Chau et al** in order to prevent either under- or over-etching of the insulating film.

Allowable Subject Matter

5. Claims 7 and 8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 7 and 8 are objected to for reasons deemed to be of record.

Response to Arguments

6. Applicant's arguments with respect to claims 1-6 and 9-12 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on

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the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colleen E. Rodgers whose telephone number is (571) 272-8603. The examiner can normally be reached on Monday through Friday, 9:00 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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